

Opportunities and approaches for doubling the structural efficiency of metallic materials

D.B. Miracle

Materials & Manufacturing Directorate, Air Force Research Laboratory, Dayton, OH USA

Significant reduction in system mass is required to achieve advanced aerospace objectives such as hypersonic flight, improved fuel efficiency and low cost access to space. Since materials with higher structural efficiency (strength or stiffness normalized by material density) provide a direct approach for reducing system mass, metallic materials with high structural efficiency can provide *enabling capabilities* through structural minimization. Although advanced methodologies in system design and assembly, such as unitized construction, can also contribute to structural minimization, these techniques typically produce components with highly stressed multi-axial local loading, furthering the reliance upon materials with high structural efficiency. While unitized construction is used with graphite/epoxy systems, this approach has not been widely practiced with current metallic materials due to their lower specific properties. Metallic materials with high specific properties will therefore improve *affordability* by replacing more expensive graphite/epoxy components and by reducing the number of parts, and hence the significant cost of assembly, in aerospace systems. Finally, metallic materials with high structural efficiency can provide *performance improvements* in existing aerospace systems by decreasing weight. In this presentation, the general needs for metallic materials with high structural efficiency will be outlined. Current approaches for achieving significant improvements in specific strength and stiffness, including titanium in-situ eutectic alloys, nanocrystalline and amorphous metals and super high strength Al alloys, will be described.